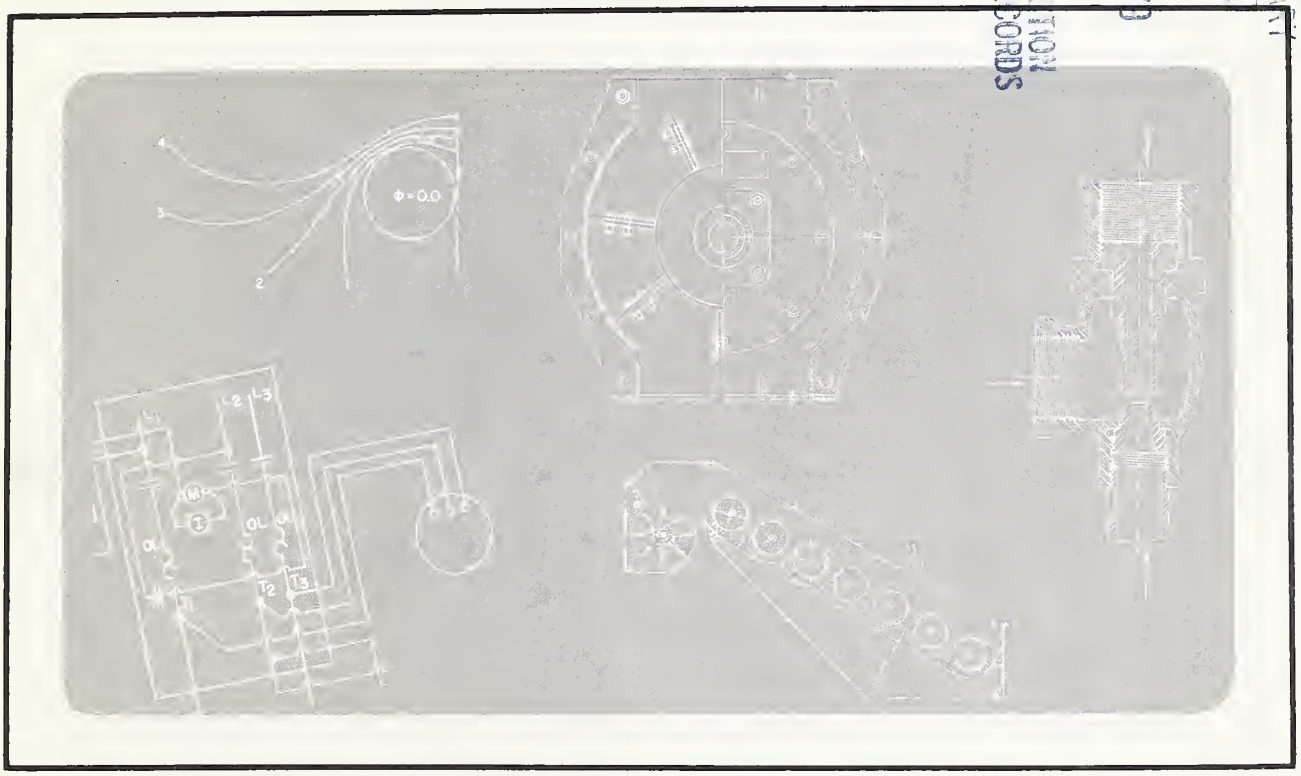
ISSN 0193-3728

Egg Planter for a Boll Weevil Mass-Rearing Operation



U.S. Department of Agriculture
Science and Education Administration
Advances in Agricultural Technology • AAT-S-6/September 1979

CONTENTS

ILLUSTRATIONS

TABLE

The research reported in this publication was done in cooperation with the Mississippi Agricultural and Forestry Experiment Station. Stanley Malone, research technician, Robert T. Gast Rearing Laboratory, Animal and Plant Health Inspection Service, and D. K. Harsh and W. C. Jordan, engineering technicians, Boll Weevil Research Laboratory, Science and Education Administration, assisted in the development and testing of the equipment.

This publication is available from the Boll Weevil Research Laboratory, P.O. Box 5367, Mississippi State, Miss. 39762.

Science and Education Administration, Advances in Agricultural Technology, Southern Series, No. 6, September 1979.

Published by Agricultural Research (Southern Region), Science and Education Administration, U.S. Department of Agriculture, P.O. Box 53326, New Orleans, La. 70153.

Egg Planter for a Boll Weevil Mass-Rearing Operation

By J. G. Griffin[1]

ABSTRACT

Equipment used in a mass-rearing operation to plant boll weevil eggs must aseptically handle, accurately meter, and uniformly disperse the eggs on the surface of the congealed larval rearing medium. The egg planter described is part of a mechanized in-line operation and consists of several components, including a filler to meter and a spray nozzle to disperse the eggs on the surface of the medium. The equipment is capable of planting boll weevil eggs at the capacity of the production line, 14 to 15 trays per minute, or about 2 to 2¼ million eggs per hour. Only the minor task of changing the holding jars containing the egg suspension is still performed manually. Index terms: *Anthonomus grandis* Boheman, insect-rearing equipment.

INTRODUCTION

Early methods and equipment for planting boll weevil (*Anthonomus grandis* Boheman) eggs required the technician to dispense the eggs manually and to count or approximate the number of eggs placed on the larval rearing medium (Vanderzant and Davich 1958, Gast 1966, Gast and Davich 1966). Sanitation problems increased as the size of the planting operation was enlarged. In developing a mechanized system for planting eggs in the boll weevil mass-rearing operation at the Robert T. Gast Rearing Laboratory, Mississippi State, Miss., we needed to eliminate the manual labor, to meter and dispense the weevil eggs more uniformly over the surface of the larval rearing medium, and to provide and maintain sanitary conditions for planting. The eggs, suspended in a sterile sugar-corn starch solution (Gast 1966), must be handled with care and spread uniformly over the surface of the larval rearing medium to obtain a maximum yield of adult weevils. This publication describes an egg planter we developed as part of a total boll weevil egg-planting operation (Griffin 1978, 1979). It is used in-line with a form-fill-seal machine to mechanize what were formerly manual operations.

EQUIPMENT

The egg planter consists of a spray nozzle and nozzle carriage, a spray shield, and a system to measure and deliver the egg suspension to the nozzle (fig. 1). Table 1 lists the components.

A pneumatic, external-mix spray nozzle, supported by a nozzle carriage (fig. 2), disperses the egg suspension over the surface of the diet in the trays and is moved back and forth over the tray cavity by an air cylinder. The cylinder is double acting and has a 1¼-inch bore and a 12-inch stroke. A collar fastens over the rod of the cylinder to limit its effective stroke to 10⅛ inches, which is ⅛ inch less than the length of the cavity in the tray. An adjustable air-motor control is used in conjunction with the cylinder and a four-way electrically operated air valve to regulate the speed of the cylinder rod. The air supply to the nozzle is filtered to remove microbes by a Millipore 142-millimeter-diameter biological filter, and the pressure is adjusted by an air-pressure regulator to about 6 pounds per square inch. Although the spray nozzle is not designed for

[1] Agricultural engineer, Boll Weevil Research Laboratory, Science and Education Administration, U.S. Department of Agriculture, P.O. Box 5367, Mississippi State, Miss. 39762.

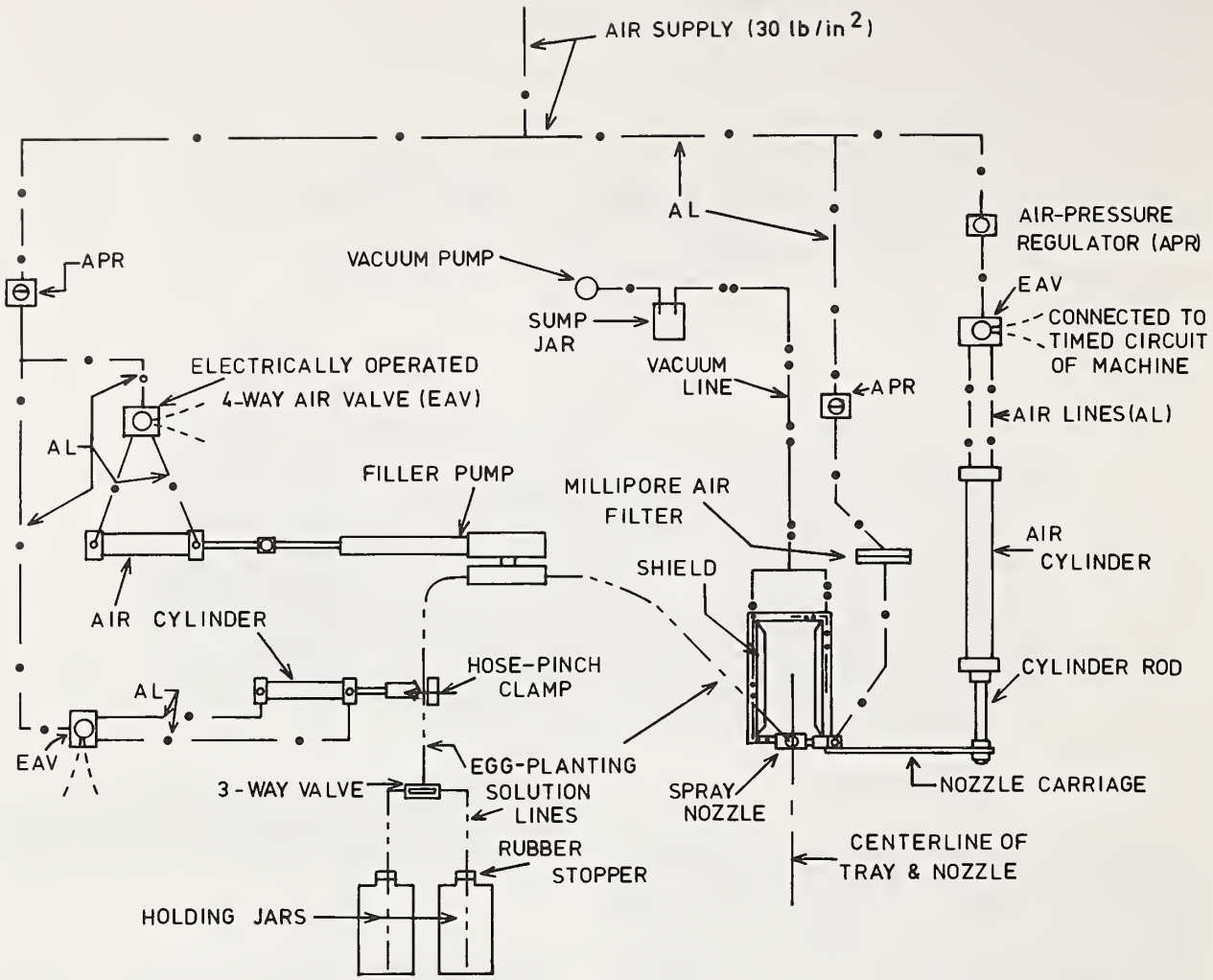


FIGURE 1.—Schematic diagram of the egg planter.

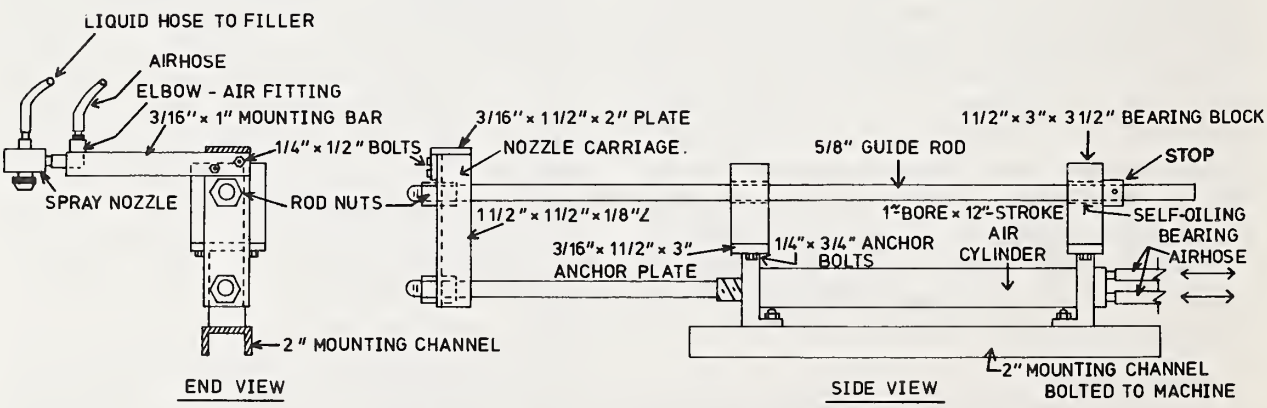


FIGURE 2.—Details of the nozzle carriage and air cylinder.

Table 1.—Components of the egg planter

Name	Make	Model/size	Description
Air filter	Millipore	142-mm diameter.	
Air motor	Aurora Air Products	HB-2	Remote control, ¾" bore, double acting, 2" stroke; drives hose-pinch clamp.
Air motor	Bellows	B8011-2001	Remote control, 1" bore, double acting, 12" stroke; drives carriage.
Air motor	Bimba	044-D	Remote control, ¾" bore, double acting, 4" stroke; drives filler pump.
Air-motor controls	M&M Flow Products	MF-250-B F1	External microadjustment.
Air-pressure regulators	Bridgeport Brass Co.	722/6340/340	Brass, with air shutoff and gage.
Air valves	Humphrey Products	125-4E1-21-35	Electric, 4-way, common intake and exhaust port.
Ball valve	Whitey	43XS4	Stainless steel, 3-way, ¼" Swagelok connections.
Filler	National Instrument Co., Inc.	Filamatic model FKS-0-10CC.	Stainless-steel barrel.
Holding jars			Glass, 3-liter capacity.
Spray nozzle	Spraying System	¼" J series	External mix, pneumatic, No. 60100 liquid cap, No. 134255-45 air cap.
Tubing		¼" O.D.	Stainless steel.
Tubing		¼" O.D.	Pure latex; for fluid, air, and vacuum lines.
Vacuum pump	Fisher Scientific	⅙ hp	Combination pressure-vacuum.

spraying the type of suspension used for planting the eggs, it does a satisfactory job of uniformly spreading the eggs over the surface of the diet, provided the viscosity of the egg suspension and the air pressure on the nozzle are correct.

A stainless-steel spray shield (fig. 3) mounted on the frame of the form-fill-seal machine surrounds the tray when it is moved by the machine into position for egg planting. The shield has a V-shaped drainage trough around the bottom. Stainless-steel suction tubes (¼-inch-outside-diameter) connect the trough and a ¼-inch tube tee. A latex hose runs from the tee to a vacuum pump. The pump is rated at 1.3 cubic feet per minute at 0-inch vacuum. A sump jar is located in the vacuum line between the pump and shield.

Two glass jars with specially prepared rubber stoppers hold the egg suspension. Each stopper has two openings for ¼-inch-O.D., stainless-steel tubes. One of the tubes extends into the jar to within approximately $^3/_{16}$ inch of the bottom, and the other tube extends only approximately 1 inch into the jar. Both of them protrude about 1½ inches outside the stopper. The longest tube in each jar connects to a ¼-inch, three-way, stainless-steel ball valve (figs. 1 and 4), which is manually controlled. A latex suction tube passes from the ball valve through a hose-pinch clamp to the filler.

Details of the metering system and the hose-pinch clamp are shown in figure 4. The clamp is powered by a ¾-inch-bore, 1-inch-stroke, double-acting air cylinder. When the clamp is closed, there is approximately $^3/_{32}$-inch clearance, which is twice the wall thickness of the tubing. A 10-cubic-centimeter-capacity filler meters and delivers the egg suspension from the holding jars to the spray nozzle. The pump of the filler is driven by a 1-inch-bore, 3-inch-stroke, double-acting air cylinder. A collar is mounted on the rod of the cylinder to regulate the length of stroke of the cylinder and pump, thereby regulating the delivery capacity of the pump per stroke. The check valve on the filler pump is a ball-and-seat type, and if the clamp were not used, eggs could become lodged between the ball and seat, allowing some of the egg suspension to flow back into the holding jar.

OPERATION AND DISCUSSION

The spray shield is fastened in position. This shield helps prevent any egg suspension from getting on the sealing flanges of the tray. The air-

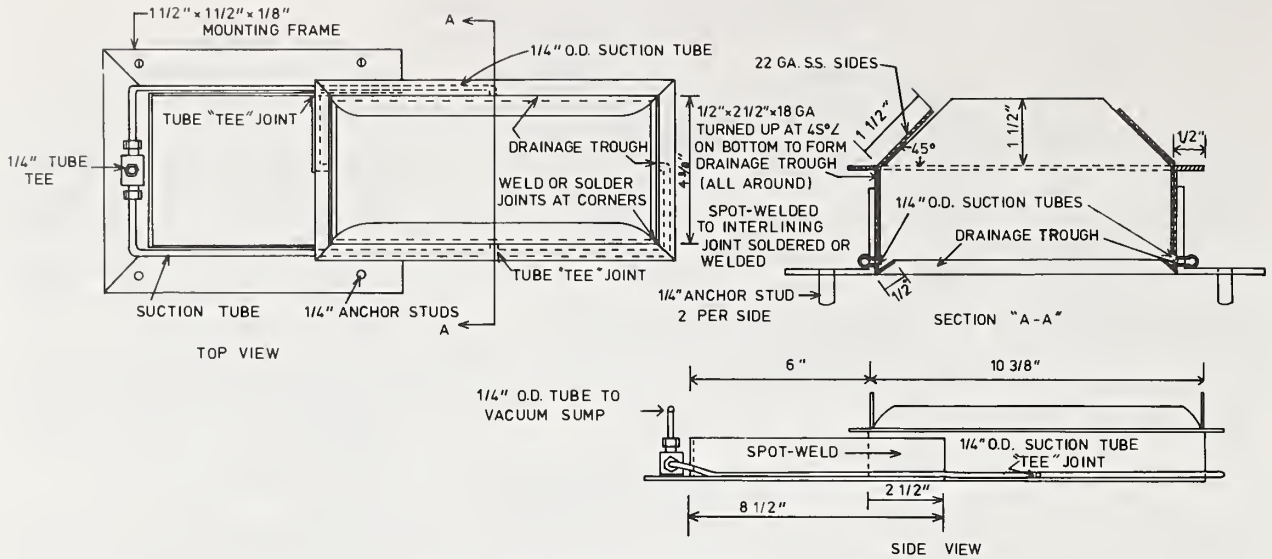


FIGURE 3.—Spray shield.

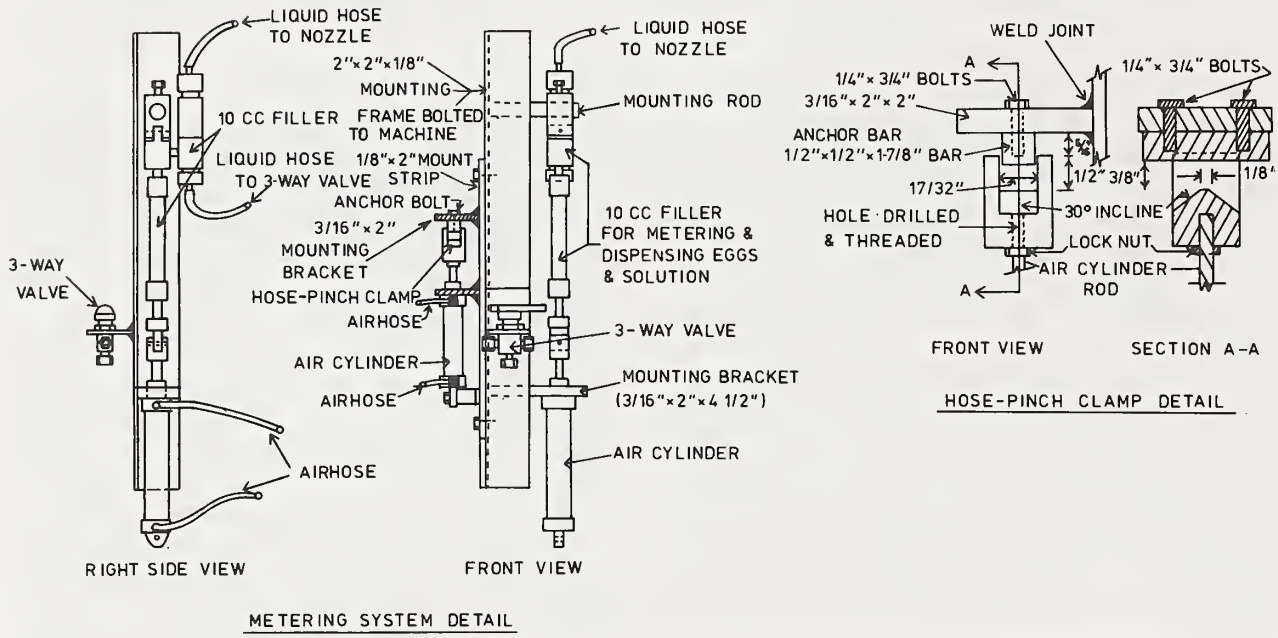


FIGURE 4.—Details of the metering system and hose-pinch clamp.

supply valve is opened; the jars of egg suspension are installed; the machine power switch is turned on; and the system is ready for operation.

When the timer switch of the form-fill-seal machine enters the "on" cycle, a source of power simultaneously energizes the three air valves which operate the air cylinders for the nozzle carriage, the filler pump, and the hose-pinch clamp. This causes the clamp to pinch the fluid suction hose closed, the filler pump to transfer the egg suspension from the pump cylinder to the nozzle, and the carriage to move the spray nozzle from one end of the tray to the other. During the "off" cycle of the timer switch, the air valves are deenergized, and the cylinders move the carriage and nozzle back to the starting position. The hose-pinch clamp opens, and on the suction stroke the filler pump brings more egg suspension from the jars to the pump cylinder.

The egg suspension is kept in holding jars to reduce the possibility of microbial contamination. When a jar is empty, the three-way valve in the fluid suction line is manually changed to the other position, allowing the pump to get egg suspension from the full jar while the empty jar is being replaced. This requires very little time or labor. The egg suspension that strikes the spray shield drains into the V-trough, and the vacuum pump draws it through the suction tubes to the sump jar. The jar is emptied and cleaned at the end of the planting operation.

The four-way air valves used on all the air cylinders connect to a power source timed by the form-fill-seal machine. The adjustable air-meter control is connected to each air valve to control the speed of movement for the cylinder rods. The operation time of each cylinder rod is synchronized with the "on" period for the power-timer switch, and the egg planter plants a tray at the same rate the form-fill-seal machine forms one, 14 to 15 per minute.

The number of eggs per tray is regulated by the ratio of eggs to the volume of suspension or by regulating the length of strokes of the pump delivering the egg suspension to the nozzle. We plant about 2,500 eggs per tray, or approximately 2 to 2¼ million eggs per hour.

REFERENCES

Gast, R. T.
1966. A spray technique for implanting boll weevil eggs on artificial diet, J. Econ. Entomol. 59: 239–40.

Gast, R. T., and Davich, T. B.
1966. Boll weevils. *In* D. N. Smith (ed.), Insect Colonization and Mass Production, pp. 405–419. Academic Press, New York and London.

Griffin, J. G.
1978. A system for the egg planting operation in boll weevil mass rearing. Trans. ASAE 21(3): 469–472.
1979. Equipment for cooling larval diet in a boll weevil mass-rearing operation. U.S. Sci. Educ. Adm. Adv. Agric. Technol. South. Ser. 1, 3 pp.

Vanderzant, E. S., and Davich, T. B.
1958. Laboratory rearing of the boll weevil: a satisfactory larvae diet and oviposition studies. J. Econ. Entomol. 51: 288–291.

U.S. DEPARTMENT OF AGRICULTURE
SCIENCE AND EDUCATION ADMINISTRATION
P. O. BOX 53326
NEW ORLEANS, LOUISIANA 70153

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF
AGRICULTURE
AGR 101

☆U.S. GOVERNMENT PRINTING OFFICE: 1979- 671-037/9A